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A CONTRIBUTION TO THE KNOWLEDGE OF *ANOLIS MACRINII* SMITH, 1968 (REPTILIA: SQUAMATA: DACTYLOIDAE)

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ABSTRACT. During three short visits to the coffee-growing region in the hills north of Pochutla (Oaxaca, Mexico), we observed *Anolis macrinii* in its natural habitat. The species appeared to be relatively abundant, and we collected 12 individuals, including several adult males. The holotype of this species was reported erroneously to be an adult male but actually is a female. The confusion might have arisen from the moderate-sized dewlap present in adult females. However, males have a very large dewlap and a pair of moderately to greatly enlarged postcloacal scales. We provide color descriptions in life for three individuals, color photographs in life, description and illustration of hemipenis morphology, and some natural history notes. Finally, we discuss the conservation status of this species.

RESUMEN. Durante tres visitas cortas a la región cafetalera en el norte de Pochutla (Oaxaca, México), observamos a *Anolis macrinii* en su habitat natural. La especie parece ser relativamente abundante y colectamos 12 individuos incluyendo varios ejemplares de machos adultos. El holotipo de esta especie fue erróneamente registrado como un adulto macho cuando en realidad es una hembra. La confusión pudo surgir del pliegue gular moderadamente grande que presentan las hembras adultas. Sin embargo los machos poseen un pliegue gular sumamente grande y un par de escamas poscloacales moderatemente a fuertemente agrandadas. Proveemos descripción de color en vida para tres individuos, fotografías a color en vida, descripción, ilustraciones de la morfología de los hemipenes y algunas notas de historia natural. Finalmente discutimos el estado de conservación para esta especie.

KEY WORDS: *Anolis macrinii*; Dactyloidae; Mexico; taxonomy; description

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In 1968, Smith described *Anolis macrinii* based on two specimens (holotype now MCZ [Harvard University] R-46202 [stated to be R-49202 in original description]; paratype now UIMNH [Illinois Natural History Survey, Center for Biodiversity] 78762) collected by Emil Macrinius at "Cafetal Santa Hedvigis, Pochutla, Oaxaca." Before their formal description, the types of this new taxon had already been in the MCZ collection for decades, and for 10 years on loan to Hobart Smith, who had doubts regarding the correctness of the locality data of these specimens and had "sought allocation with some Caribbean or other foreign species" (Smith, 1968:143). Lieb (1981) mentioned an additional specimen (now MVZ [Museum of Vertebrate Zoology, University of California, Berkeley] 165249) that he allocated to *A. macrinii*. In recent years additional specimens of *A. macrinii* have been collected by Mexican and U.S. herpetologists (deposited mostly in the MZFC [Facultad de Ciencias, Museo de Zoología, Universidad Nacional Autónoma de México] collection in Mexico City). However, little has been published on the biology and morphological variation of this species. A photo in life of this anole has been made available on the Internet (Gray *et al.*, 2012). However, contrary to what is stated on the respective website, the pictured specimen is not a male but rather a female, as judged by coloration and size of the dewlap.

During three visits to the coffee-growing region in the hills north of Pochutla (Oaxaca, Mexico), we observed *A. macrinii* in its natural habitat. The collected specimens have been deposited in the collection of the Senckenberg Forschungsinstitut Frankfurt (SMF) and in the Instituto de Biología (IBH), Universidad Nacional Autónoma de México, México D.F., Mexico. GK had the privilege of examining the holotype of *A. macrinii* (MCZ R-46202). Abbreviations for museum collections follow Sabaj Pérez (2010). The capitalized colors and color codes (the latter in parentheses) are those of Köhler (2012). Terminology of markings used in color descriptions follow Köhler (2012). Coordinates and elevation were recorded using Garmin GPS receivers with built-in altimeters. All coordinates are in decimal degrees, WGS 1984 datum, and rounded to the fifth decimal place. Temperature in the natural habitat of *A. macrinii* was recorded with automatic data loggers (HOBO Pendant® Temperature Data Logger 8K) placed about 100 cm above the ground just below the village of La Galera (at 15.97250°N, 96.48138°W, 1,160 m above sea level) and set to a recording interval of 10 min. Before preservation, we kept our *A. macrinii* in small terraria to secure fecal droppings. These samples were preserved in 96% ethanol and later checked for food remains in the lab. Head length was measured from the tip of the snout to the anterior margin of the ear opening, with the calipers held in a vertical position relative to the head. Snout length was measured from the tip of the snout to the anterior border of the orbit, with the calipers held in a horizontal position relative to the head. Head width was determined with the broad tips of the calipers aligned with the levels of posterior margin of eye and supralabial scales, respectively, with the calipers held in a vertical position relative to the head. Dorsal and ventral scales were counted at midbody along the midline. Tail height and width were measured at the point reached by the heel of the extended hind leg. Subdigital lamellae were counted on Phalanges II to IV of Toe IV of the hind limbs and separately on distal phalanx. We considered the scale directly anterior to the circumnasal to be a prenasal. Abbreviations used are axilla-groin distance (AGD), horizontal diameter of tail (HDT), head length (HL), head width (HW), infralabial scales (IFL), interparietal plate

(IP), shank length (ShL), snout length (SL), subocular scales (SO), supralabial scales (SPL), supraorbital semicircles (SS), snout–vent length (SVL), tail length (TL), and vertical diameter of tail (VDT). In reporting the frequencies of character states, we used the following terminology: if a character state was present in more than 65% of the examined specimens, we coded it as "usually"; < 65% but > 20% "commonly"; < 20% but > 5% "occasionally"; and < 5% "exceptionally." To measure dewlap area, we took photographs of males in life with their dewlaps artificially extended using small forceps. The head portion was magnified and printed and then superimposed on millimetric paper; the total number of millimeter squares contained in the extended dewlap was counted. A straight line was drawn between the anterior and posterior insertions of the dewlap. The HL on the printout was also determined. We used the following equation to convert the magnified dewlap area to the real size: $X = [(Y^{-2}/A)B]^2$, where X is the real area (mm^2) of the dewlap, Y is the total area (mm^2) of the dewlap at a magnified scale, A is the HL measure (mm) of the anole at a magnified scale, and B is the HL measure (mm) of the anole at the real size. Recently, Nicholson *et al.* (2012) proposed a new classification for the anoles, seriously questioned by several researchers (Castañeda and de Queiroz, 2013; Poe, 2013). We choose to be conservative until this debate has been settled and use the name *Anolis* in this article.

From 12–15 November 2012, three of us (GK, RGTP, and MGP) visited the village of Santiago La Galera, which is situated in a coffee-growing region (Figs. 1a–c). In the vicinity of Santiago La Galera, *A. macrinii* appeared to be relatively abundant, and we collected seven individuals, including one adult male (Figs. 2a–f). During two additional visits (4–6 March 2013, 19–22 June 2013), GK and RGTP visited several localities in this region and secured additional specimens of *A. macrinii*. In total, we collected 12 individuals of this species. To obtain more realistic statistical data on the variation in external morphology of *A. macrinii*, we also examined 10 additional specimens of this species from various museum collections (see Appendix I).

The holotype of this species (Figs. 3a–f) was reported erroneously to be an adult male but actually is a female. The confusion might have arisen from the moderate-sized dewlap present in adult females (Figs. 4c, d). However, males have a very large dewlap (Figs. 4a, b) and a pair of moderately to greatly enlarged postcloacal scales (Fig. 5). Our specimens agree well with the holotype in external morphology. Following is a description of *A. macrinii* based on the 22 specimens of the species available to us. For variation in selected characters, see also Table 1.

Description. Anolis macrinii is a large anole (maximum recorded SVL 95.0 mm in males, 96.0 mm in females); dorsal head scales in internasal region mostly keeled, other dorsal head scales smooth, rugose, or tuberculate; moderately deep prefrontal depression present, parietal depression absent; 5–7 postrostrals; anterior nasal divided, the lower scale in contact with rostral and first supralabial (Fig. 6); 6–8 internasals; canthal ridge sharply defined; scales comprising supraorbital semicircles weakly keeled (especially anterior ones, whereas posterior ones smooth or with rounded keel), largest scale in semicircles larger than largest supraocular scale; supraorbital semicircles well defined; usually a single scale separating supraorbital semicircles at narrowest point, two scales separating supraorbital semicircles at narrowest point in one specimen (ENS 12012 [MZFC uncatalogued]), narrowly in contact in two specimens (MCZ R-46202, UIMNH 78762); 0–3 scales

Figure 1. a–c, Habitat of *Anolis macrinii* near Santiago La Galera, Oaxaca, Mexico.

separating supraorbital semicircles and interparietal at narrowest point; interparietal well defined, greatly enlarged relative to adjacent scales, surrounded by scales of moderate size, longer than wide, usually about the same size as ear opening; 2–8 moderately to greatly enlarged supraoculars; enlarged supraoculars usually separated from supraorbital semicircles by a complete row of small scales, occasionally these scales narrowly in contact (e.g., narrowly in contact on one side in IBH 26580); 2–3 rows of small scales between enlarged supraoculars and superciliaries; 2–3 elongate superciliaries, anterior one longest, followed posteriorly by a series of 4–5 squarish, keeled scales of moderate size (Figs. 6e, f); 3–4 enlarged canthals; 6–9 scales between second canthals; 6–11 scales present between posterior canthals; loreal region slightly concave, 24–41 mostly keeled (some smooth or rugose) loreal scales in a maximum of 5–7 horizontal rows; 6–9 supralabials to level below center of eye; suboculars smooth, tuberculate, or keeled, in broad contact with supralabials (1–3 suboculars in contact with 1–4 supralabials); ear opening vertically oval; scales anterior to ear opening keeled granulars, slightly larger than those posterior to ear opening; 6–10 infralabials to level below center of eye; usually 4, occasionally 5 or 6, postmentals, outer pair at least four times larger than adjacent median postmental scales (Figs. 6c, d); 0–3 (usually 2) enlarged sublabials in contact with infralabials on each side; keeled granular scales present on chin and throat; male dewlap very large, size 987, 1,255, and 1,463 mm^2, respectively, in three adult males (SMF 96208, 96388, 96387), extending well onto venter; female

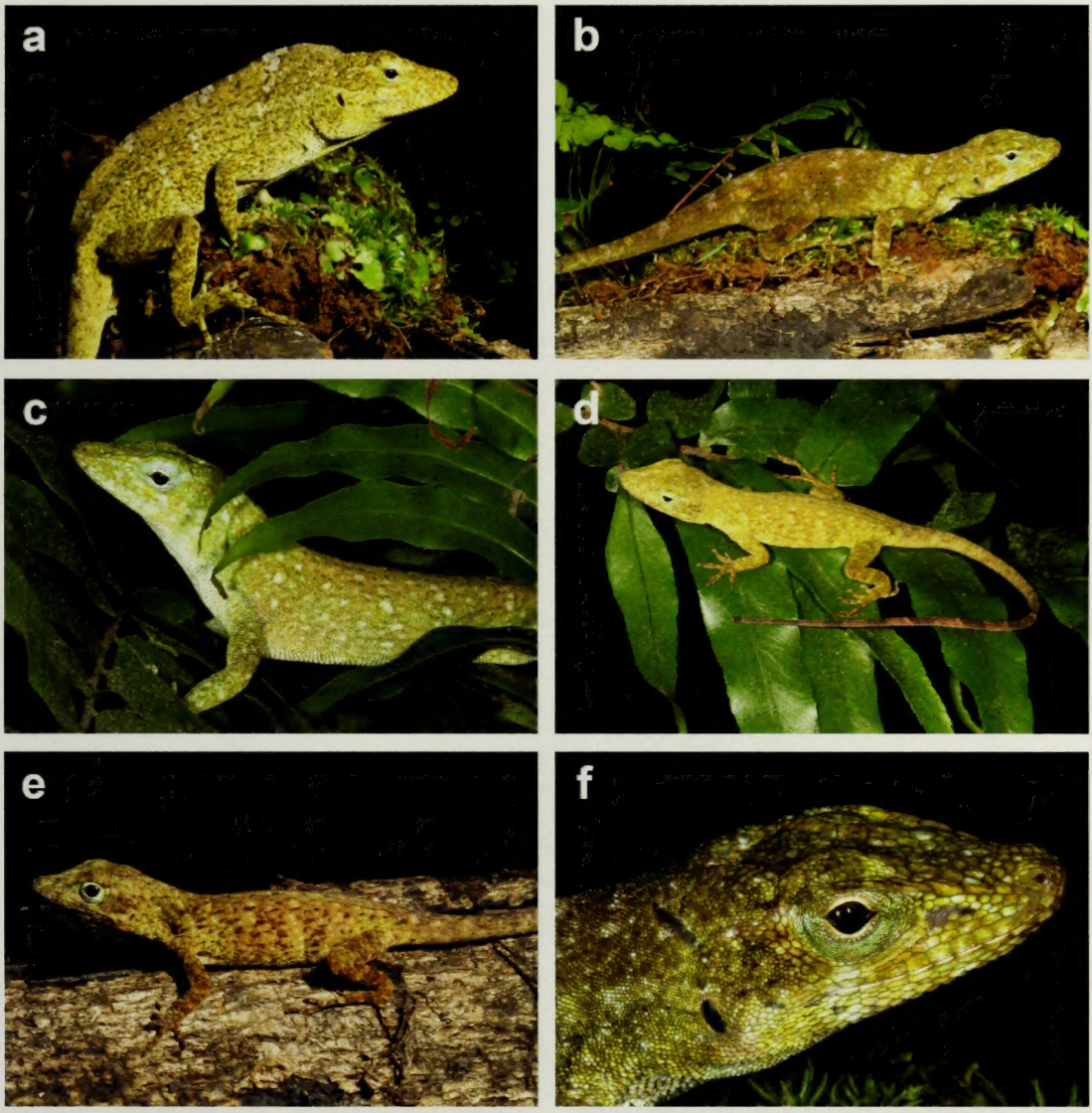

Figure 2. *Anolis macrinii* in life. a, Adult male (SMF 96208; SVL 85.0 mm); b, adult female (SMF 96210; SVL 86.0 mm); c, adult female (IBH 26577; SVL 96.0 mm); d, subadult male (IBH 26583; SVL 70.0 mm); e, juvenile female (SMF 96209; SVL 50.0 mm); f, adult female (SMF 96210).

dewlap of moderate size, size 227 and 342 mm^2, respectively, in two adult females (SMF 96210, IBH 26577), extending onto chest; 9–11 horizontal gorgetal-sternal rows with 28–37 scales per row; modal number of marginal pairs 4–5; a nuchal crest and a dorsal ridge present in males; 2–6 middorsal scale rows slightly enlarged, weakly keeled, dorsal scales lateral to middorsal series gradually larger than granular lateral scales (Figs. 7a, b); no enlarged scales scattered among granular laterals in adults, but such scales present in the two juveniles (SVL 50–59 mm; Figs. 8a–d); 63–85 dorsal scales

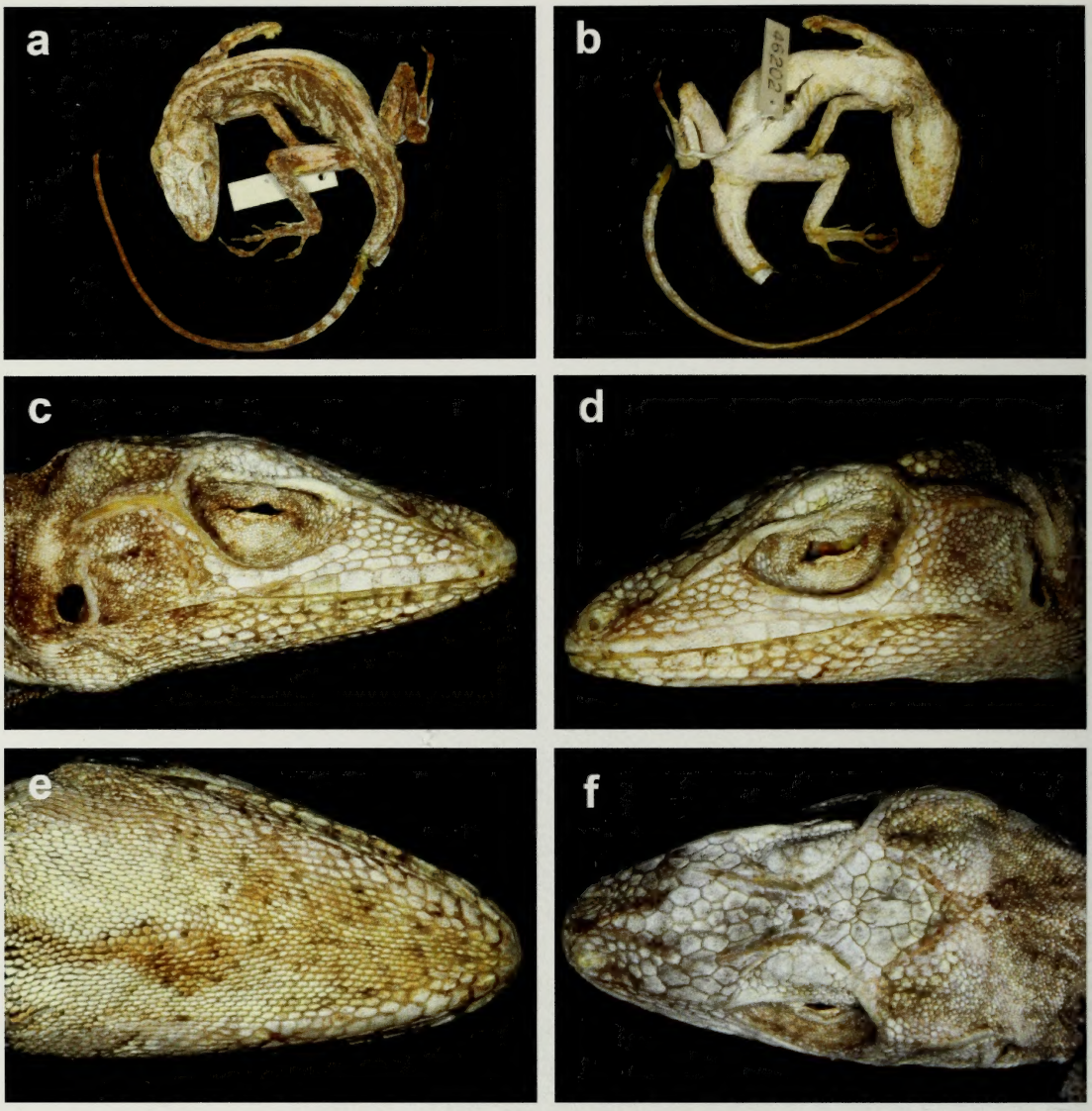

Figure 3. Holotype of *Anolis macrinii* (MCZ R-46202): a, dorsal view; b, ventral view; c, right lateral view of head; d, left lateral view of head; e, ventral view of head; f, dorsal view of head. SVL 85.5 mm. Photos by G. Köhler. ©President and Fellows of Harvard College. Museum of Comparative Zoology, Harvard University.

along vertebral midline between levels of axilla and groin in males, 65–87 in females; 38–58 dorsal scales along vertebral midline contained in one head length in males, 38–52 in females; ventral scales on midsection slightly larger than largest dorsal scales; scales on midventer smooth to weakly keeled, subimbricate to imbricate with rounded posterior margins (Figs. 7c–f); 62–78 ventral scales along midventral line between levels of axilla and groin in males, 59–78 in females; 40–64 ventral scales contained in one head length in males, 34–58 in females; 134–162 scales around mid-

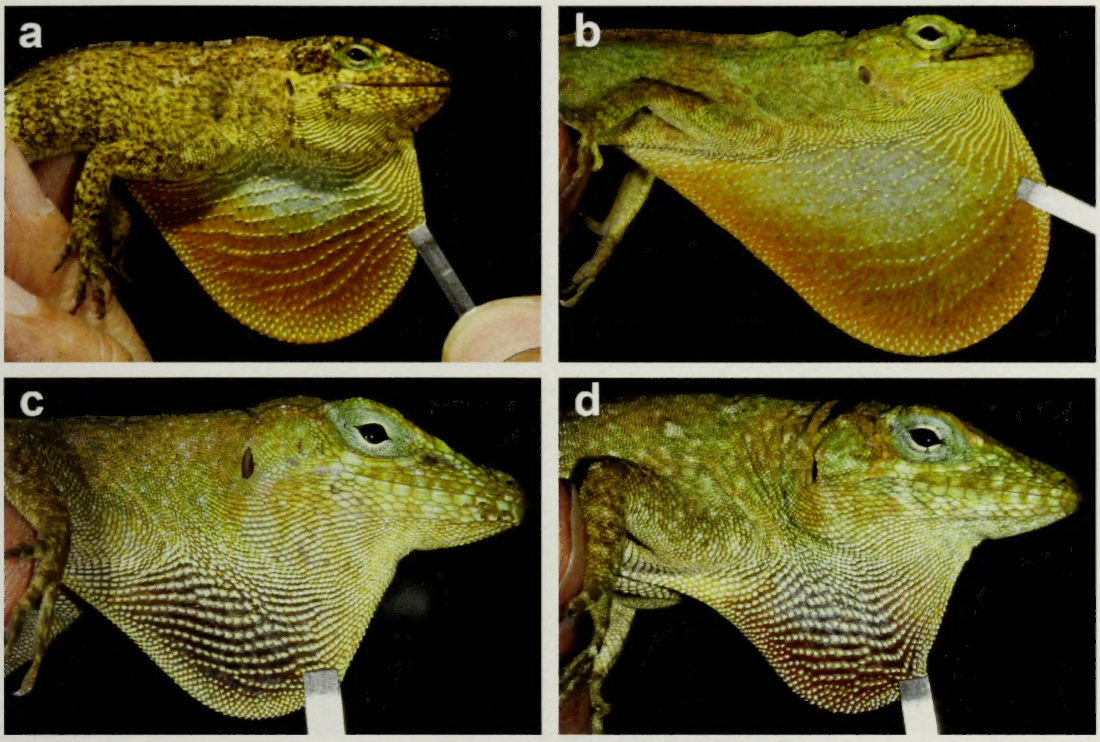

Figure 4. *Anolis macrinii* with extended dewlap in life. a, Adult male (SMF 96208; SVL 85.0 mm); b, adult male (SMF 96388; SVL 90.0 mm); c, adult female (SMF 96210; SVL 86.0 mm); d, adult female (IBH 26577; SVL 96.0 mm).

body in males, 132–158 in females; tube-like axillary pocket absent; precloacal scales not keeled; males with 2–4 moderately to greatly enlarged postcloacal scales; tail laterally compressed in cross section, tail height/tail width 1.04–1.64 in males, 1.26–1.52 in females; basal subcaudal scales smooth or weakly keeled; lateral caudal scales keeled, homogeneous, although an indistinct division in segments is discernible; dorsal medial caudal scale row enlarged, keeled, not forming a crest; scales on anterodorsal surface of brachium and on dorsal surface of antebrachium keeled, unicarinate; 31–41 subdigital lamellae on Phalanges II–IV of Toe IV of hind limbs; 7–10 subdigital lamellae on distal phalanx of Toe IV of hind limbs; digital pads dilated, slightly more than three times the width of distal phalanx; in the 12 newly collected specimens, the longest toe of the adpressed hind leg reaches usually to level of tympanum, occasionally to posterior margin of eye. For variation in selected scalation and morphometric characters, see Table 1.

The completely everted hemipenis of SMF 96387 (Fig. 9) is a small, slightly bilobate organ; lobes weakly developed; sulcus spermaticus bordered by well-developed sulcal lips and opening into a broad concave area on apex, somewhat divided medially; a well-developed asulcate ridge and a small asulcate processus present; asulcate side of apex strongly calyculate; asulcate ridge and truncus with transverse folds.

The coloration in life of an adult male (SMF 96208; Figs. 2a, 4a) was recorded as follows: Dorsal ground color Olive Yellow

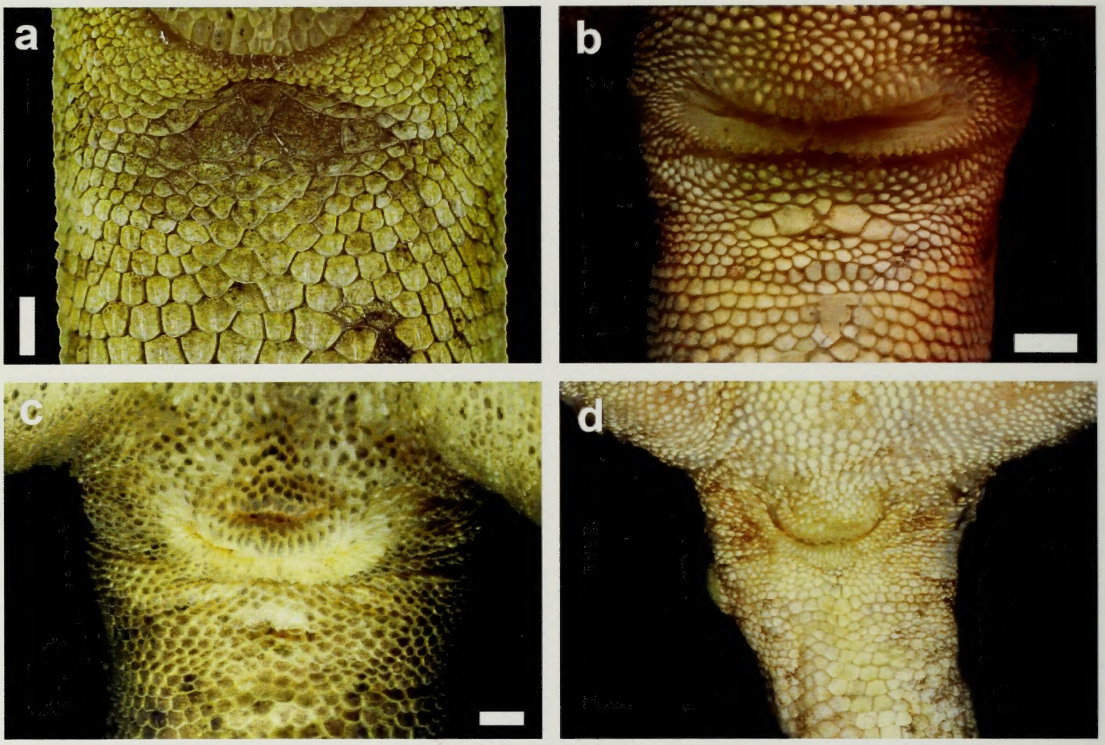

Figure 5. *Anolis macrinii*: cloacal scalation in, a, SMF 96387; b, IBH 26580; c, SMF 96207; d, MCZ R-46202. Scale bars = 1 mm.

(117) with Greenish Olive (125) and Dark Brownish Olive (127) splotches and streaks; a Medium Lime Green (114) ring around eye; dorsal surface of tail Olive Yellow (117) with Army Brown (46) bands and grading into Vandyke Brown (282) toward tip; dewlap Light Chrome Orange (76) with a suffusion of Buff (15) and a Pale Neutral Gray (296) basal blotch; ventral surface of head Pale Greenish Yellow (86) with Olive Clay Color (85) stipples; ventral surfaces of body and limbs Chamois (84); ventral surface of tail Trogon Yellow (81) with Olive Clay Color (85) stipples and grading into Vandyke Brown (282) toward tip; iris Brick Red (36).

The coloration in life of an adult female (SMF 96207) was recorded as follows: Dorsal ground color Lime Green (116) with a suffusion of Clay Color (18) middorsally and with oblique rows of Cyan White (155) splotches; dewlap Mars Brown (25) with Chamois (84) scales; a Medium Paris White (140) ring around eye; ventral surface of head Pale Lime Green (112) with suffusions of Olive Yellow (117); ventral surfaces of body, limbs, and tail Pale Buff (1); iris Brick Red (36).

The coloration in life of a juvenile female (SMF 96209; Fig. 2e) was recorded as follows: Dorsal ground color Olive Clay Color (85) with Pale Greenish White (97) scattered scales and with a diffuse Raw Umber (22) reticulum; dorsal surface of tail Raw Umber (22) with Sepia (279) bands; a Greenish Glaucous (271) ring around eye; dewlap Dark Salmon Color (252) with Warm Buff (4) gorgetals and marginals; ventral surfaces of head, body, and limbs Pale Pinkish Buff (3); ventral head suffused with Buff (5); Mikado

TABLE 1. SELECTED MEASUREMENTS, PROPORTIONS, AND SCALE CHARACTERS OF *ANOLIS MACRINII*. RANGE IS FOLLOWED BY MEAN VALUE AND STANDARD DEVIATION IN PARENTHESES. FOR ABBREVIATIONS, SEE TEXT.

	Anolis macrinii (♂ 10, ♀ 12)
Maximum SVL	
Males	95.0
Females	96.0
TL/SVL	
Males	1.91–2.00 (1.96 ± 0.04)
Females	1.89–2.10 (2.01 ± 0.09)
VDT/HDT	
Males	1.04–1.64 (1.37 ± 0.21)
Females	1.26–1.52 (1.40 ± 0.11)
AGD/SVL	
Males	0.38–0.42 (0.40 ± 0.02)
Females	0.39–0.47 (0.42 ± 0.03)
HL/SVL	
Males	0.27–0.31 (0.28 ± 0.01)
Females	0.26–0.30 (0.28 ± 0.01)
HL/HW	
Males	1.59–1.82 (1.73 ± 0.08)
Females	1.59–1.85 (1.70 ± 0.08)
SL/SVL	
Males	0.12–0.14 (0.13 ± 0.01)
Females	0.12–0.15 (0.13 ± 0.01)
SL/HL	
Males	0.45–0.49 (0.47 ± 0.02)
Females	0.43–0.49 (0.47 ± 0.02)
ShL/SVL	
Males	0.22–0.25 (0.24 ± 0.01)
Females	0.22–0.24 (0.24 ± 0.01)
ShL/HL	
Males	0.71–0.92 (0.85 ± 0.06)
Females	0.73–0.91 (0.84 ± 0.05)
Subdigital lamellae on Phalanges II–IV of Toe IV	31–41 (35.6 ± 2.5)
Subdigital lamellae on distal phalanx of Toe IV	7–10 (8.6 ± 0.8)
No. of scales between SS	0–2 (1.0 ± 0.4)
No. of scales between IP and SS	0–3 (1.5 ± 0.7)
No. of scales between SO and SPL	0
No. of SPL to level below center of eye	6–9 (7.9 ± 0.6)
No. of IFL to level below center of eye	6–10 (8.0 ± 0.7)
Total No. of loreals	24–41 (31.2 ± 4.2)
No. of horizontal loreal scale rows	5–7 (5.4 ± 0.5)
No. of postrostrals	5–7 (5.6 ± 0.6)
No. of postmentals	4–6 (4.4 ± 0.7)
No. of sublabials	0–3 (1.9 ± 0.6)
No. of scales between nasals	6–8 (7.1 ± 0.5)
No. of moderately to greatly enlarged supraoculars	2–8 (5.0 ± 1.4)

TABLE 1. CONTINUED.

	Anolis macrinii (♂ 10, ♀ 12)
No. of scales between 2nd canthals	6–9 (7.3 ± 1.0)
No. of scales between posterior canthals	6–11 (8.3 ± 1.4)
No. of medial dorsal scales in one head length	38–58 (43.3 ± 6.1)
No. of ventral scales in one head length	34–64 (46.8 ± 9.0)
No. of medial dorsal scales between levels of axilla and groin	63–87 (73.7 ± 7.5)
No. of ventral scales between levels of axilla and groin	59–78 (67.5 ± 6.0)
No. of scales around midbody	132–162 (145.8 ± 10.8)

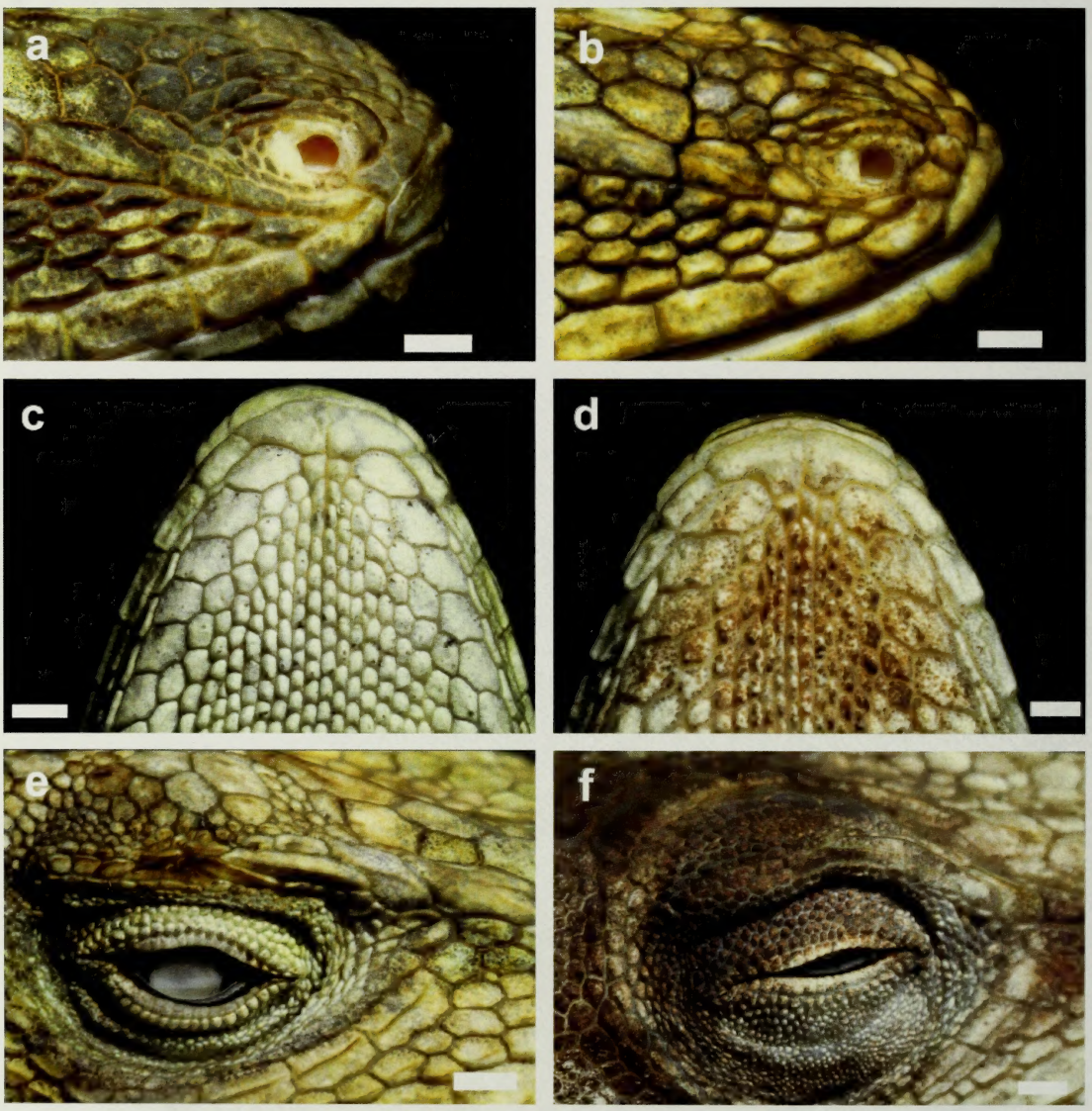

Figure 6. *Anolis macrinii*: nasal scalation in, a, SMF 96207; b, SMF 96208; chin scalation in, c, IBH 26577; d, UTA R-52813; superciliary scalation in, e, SMF 96208; f, UTA R-52813. Scale bars = 1 mm.

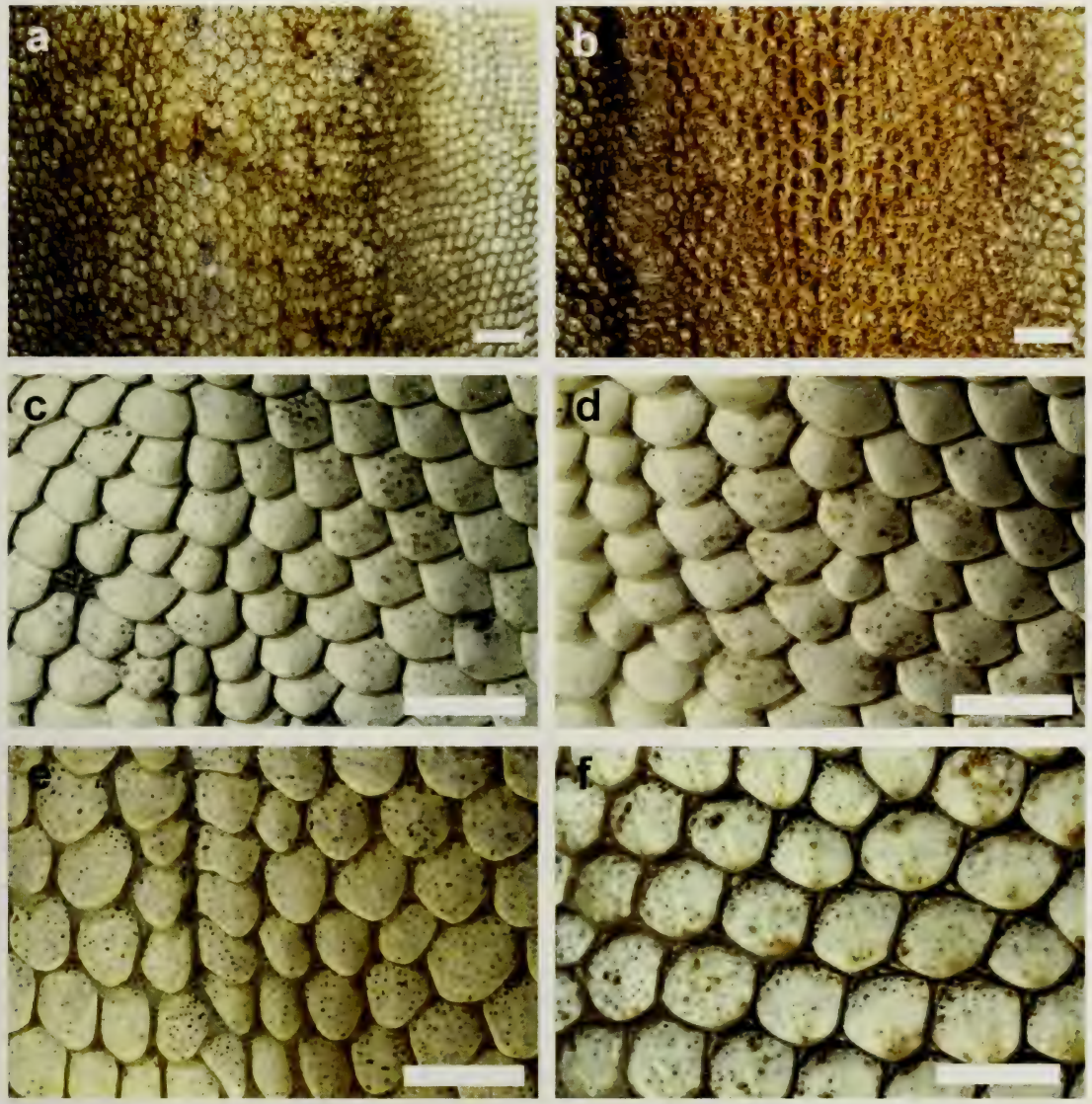

Figure 7. *Anolis macrinii*: middorsal scalation in, a, SMF 96210; b, UTA R-52813; midventral scalation in, c, SMF 96208; d, SMF 96210; e, SMF 96388; f, UTA R-52813. Scale bars = 1 mm.

Brown (42) lip bars partially reach into ventral head; iris Chestnut (30).

Whereas the majority of specimens of *A. macrinii* have a more or less uniformly colored dorsum, ENS 12012 (MZFC uncatalogued) has distinct dark broad bands running transversely across the dorsal and lateral surfaces of the body (Fig. 10).

Natural History Notes. The habitat of *A. macrinii* in the vicinity of Santiago La Galera is mostly semideciduous forest, but we found some individuals also on trees within shaded coffee plantations. The specimens we collected were perched mostly on bushes and small trees, 100–250 cm above the ground. Two individuals were found at night, the

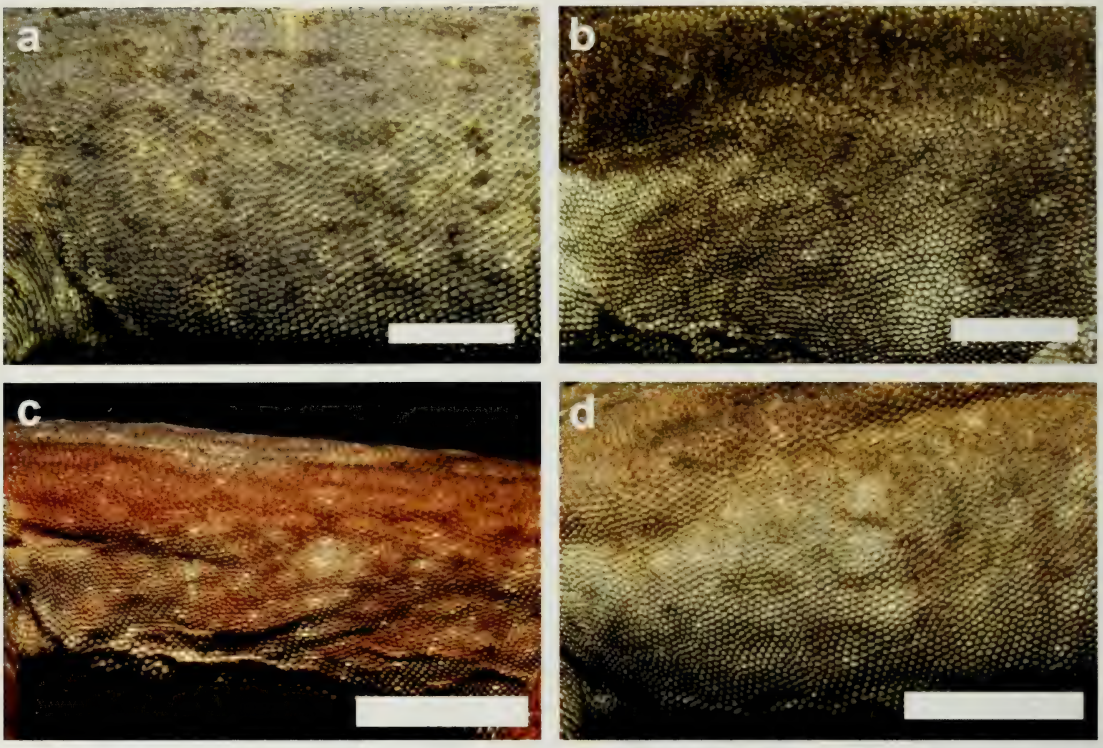

Figure 8. *Anolis macrinii*: flank scalation in, a, SMF 96207; b, SMF 96208; c, SMF 96209; d, IBH 26580. Scale bars = 5 mm.

others during daytime. Those discovered during the day were all awake, usually motionless, and very well camouflaged. The two specimens encountered sleeping at night were a subadult male (IBH 26580), which was on a branch of a bush about 150 cm above the ground, and an adult female that was sleeping on a coffee leaf with the head

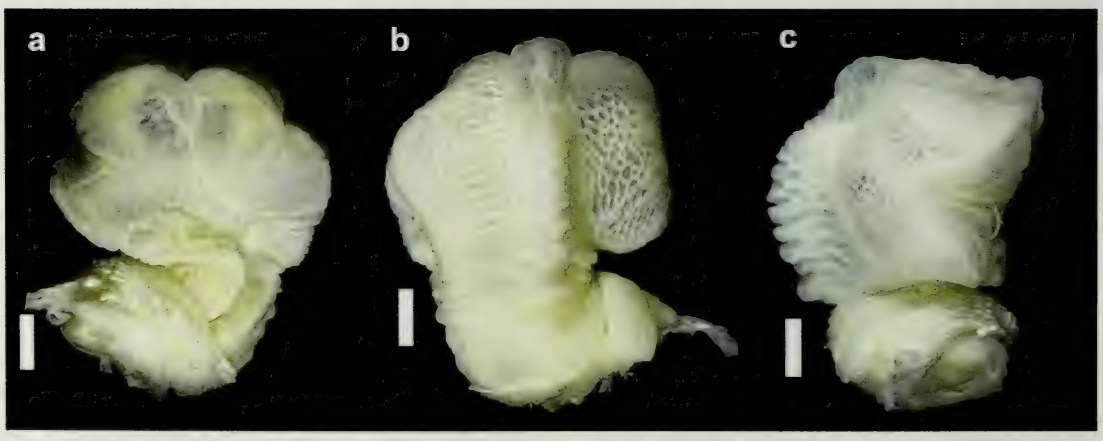

Figure 9. *Anolis macrinii*: everted hemipenis of SMF 96387. a, Sulcate view; b, asulcate view; c, lateral view. Scale bar = 1 mm.

Figure 10. Subadult male of *Anolis macrinii*, ENS 12012 (MZFC uncatalogued; SVL 66.0 mm); note broad dark dorsal bands on body.

pointing up toward the main branch. At midday, one juvenile was encountered sitting head down on one of the main vertical branches of a coffee plant. Our datalogger readings of about two complete days showed a minimum temperature of 17.6–18.0°C between 03:00 and 08:40 h. The highest temperatures were recorded in the time period between 12:20 and 14:40 h, with values of 24.3–25.1°C. Analysis of the fecal droppings revealed remains of Caelifera, Coleoptera, and Heteroptera.

Conservation Status. On the IUCN Red List of Threatened Species, *A. macrinii* is listed as Least Concern, and the population trend is given as stable (IUCN, 2012). Although we wonder who has the data to support this supposed population trend—given that so few specimens are known to science. We would agree that this species was not uncommon in the surroundings of Santiago La Galera, as evidenced by the seven individuals we encountered during three days of search. On the other hand, this species is given a Conservation Status Score of 3 by Wilson and Townsend (2010), which is the highest level of conservation concern, essentially the opposite of the IUCN determination. It indicates restriction to a single country, physiographic region, and vegetation zone. More field work is needed to get a better understanding of the population size and the geographic distribution of this species. On the national level, *A. macrinii* is in the category "special protection" (Pr) by NOM-059-SEMARNAT-2010, the lowest category (Diario Oficial de la Federación, 2010).

DISCUSSION

Aside from the original description, the only comments on *A. macrinii* are those found in the unpublished dissertation of Carl Lieb (1981). He had examined the holotype and one additional specimen of this species (MVZ 165249) and repeated the error that the holotype was a male, which in turn led him to the statement that males in *A. macrinii* have a "small throat-fan evident in male holotype" (Lieb, 1981:115). He judged this character in combination with the supposedly "ventral keeling, however faint" as evidence against a close relationship of *A. macrinii* with the "*gadovi* group anoles" and suggested that "its affinities would probably lie with the *A. petersi* series" (Lieb, 1981:115). We agree with Lieb (1981) that in external morphology, *A. macrinii* is most similar to three other large anoles, namely *Anolis biporcatus* (Wiegmann, 1834; Atlantic versant of southern Mexico through Central America to northern South America), *Anolis loveridgei* Schmidt, 1936 (northern Honduras), and *Anolis petersii* Bocourt, 1873 (Atlantic versant of southern Mexico to western Honduras). Zoogeographically, *A. macrinii* seems best interpreted as the Pacific versant representative of an otherwise Atlantic versant group of large anole species.

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Appendix I. Specimens Examined

Anolis macrinii—**Mexico:** Oaxaca: Cafetal Santa Hedvigis near Pochutla: MCZ R-46202, UIMNH 78762; Carretera Pochutla-San José Pacífico: ENS 12012, 12022 (MZFC uncatalogued); Copalita: SMF 96209; Desviación a molino de Piedra Juquilita: MZFC 22631; Pluma Hidalgo: MZFC 16565; near Pluma Hidalgo: SMF 96387, SMF 96647-48; Río Eureka, Pluma Hidalgo: MZFC 22636; Santiago la Galera: IBH 26577, 26580, 26583; SMF 96207, 96210; Sierra Madre del Sur, Santiago La Galera: MZFC 16425; Taquería Santiaguita: SMF 96208; Tierra Blanca: SMF 96649; near Tierra Blanca: SMF 96388; Carretera Pochutla-Oaxaca: UTA R-52813; 41.4 km S of San Miguel Suchixtepec [by Mexico Hwy. 175]: MVZ 165249.

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